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FEDERAL GEOGRAPHIC DATA COMMITTEE

Theme Implementation Plan for Geodetic Control Theme

National Oceanic and Atmospheric Agency (NOAA)

Federal Geographic Data Committee (FGDC)

11/20/2017

Geodetic Control Theme FY17 Implementation Plan Report

Overview

As part of meeting the requirements under OMB Circular A–16 *Supplemental Guidance* and OMB Circular A-16 Appendix E - NGDA Data Themes, Definitions, and Lead Agencies for NGDA Portfolio Management and NGDA Theme Management, NGDA Themes Leads for a Theme, in coordination with associated NGDA Dataset Managers, have developed Theme Strategic Plans and corresponding implementation plans for each Theme in the NGDA Portfolio. This report provides information on implementing the goals, objectives, and actions outlined in the Theme's Strategic Plan (link below). The report includes information on Theme Personnel (Table 1), National Geospatial Data Asset (NGDA) Datasets associated with the Theme (Table 2), and the human and financial resources needed to manage the Theme (Table 3). Table 4 provides a status update on progress made in in the current reporting period toward meeting Theme Strategic Plan goals and objectives. Table 5 provides details on the Theme Implementation Plan.

Background Information for this Theme Implementation Plan

Geodetic Control is a National Geospatial Data Asset (NGDA) as required by OMB Circular A–16 *Supplemental Guidance*. There are four datasets that comprise this Theme:

1. Continuously Operating Reference Stations (CORS)
2. Airborne Gravity (GRAV-D)
3. Geodetic Control Information on Passive Marks
4. Geoid Models

These data, as with all NGDA datasets, are stored in a database shared by both the Geoplatform.gov and Data.gov websites. The main webpage for this Theme can be found at:

https://communities.geoplatform.gov/ngda-geodeticcontrol/

On this page, additional information can be found regarding Geodetic Control including the Theme Strategic Plan, this and any prior Theme Implementation Plans (TIP), as well as links to the four dataset pages and further links to the associated datasets. The Theme Strategic Plan was developed as part of the 2014-16 NGDA Management Plan that includes information from existing agency plans and encompasses the entire Theme. These can be found on the GeoPlatform.gov NGDA Theme Community pages (https://communities.geoplatform.gov/ngda-portfolio/ngda-theme-communities/). The Theme Strategic Plans are intended to facilitate management of the Theme. The FGDC Steering Committee identified an additional 2016-17 FGDC priority for each Theme to develop a Theme Implementation Plan (TIP) that documents and assesses Theme Strategic Plan activities while continuing to advance geospatial portfolio management. This document represents the Geodetic Control TIP for 2017 and 2018.

The datasets in this Theme are fairly mature and well established. Many aspects of these datasets are either operational or at a quasi-stationary state. They do not have specific goals and tasks that need to be accomplished during FY2018 as a sub-component of a broader Strategic Plan.

On a daily basis, CORS data from nearly 2,000 sites scattered across the country are ingested, checked, and archived. This represents a steady state of affairs. Site operators are contacted if testing determines suspicious results or if the CORS site appears to be down. Development of the Foundation CORS does represent a task that can be evaluated a part of this TIP and is given below. Airborne Gravity data have very specific collection metrics on a yearly basis and are evaluated against the Government Performance and Results Act (GPRA). This too is given below with specific numbers for FY 17 and FY 18. Geodetic Control on Passive Marks is very mature dataset that is at a steady state of affairs. Geoid Models are developed on an annual basis for experimental geoid models (e.g., xGEOID18) and on a more irregular basis for national official models. For the latter case, none are planned during FY 18.

Actions and milestones that will be accomplished this Fiscal Year are given in the tables below with specific details drawn from current plans and milestones at the National Geodetic Survey.

Theme Strategic Plan

https://communities.geoplatform.gov/ngda-geodeticcontrol/wp-content/uploads/2017/12/Geodetic-Control-Theme-Strategic-Plan_FY17-FY22_-20170725.pdf

Theme Personnel

Theme personnel play a vital role in the operation and maintenance of a Theme. They are "individuals who provide interdepartmental leadership and coordination at the NGDA Theme level. They work with component NGDA Dataset Managers to develop standards and provide guidance. The NGDA Theme Lead, or designee, chairs the NGDA Theme's Thematic Committee and manages the annual process of providing NGDA Dataset collaboration and funding recommendations to the FGDC Steering Committee for those NGDA Datasets within their NGDA Theme. Additionally, the NGDA Theme Lead reports to the Executive NGDA Theme Champion and the FGDC Coordination Group on the NGDA Theme's activities and investments (both current and planned)." Table 1 provides a summary of current Theme Personnel followed by Table 2 that lists the NGDA Datasets that comprise the Theme.

Theme Personnel	
Theme Lead (Co-Leads):	Dr. Daniel R. Roman
Theme Lead Agency(ies):	**NGS, NOS, NOAA**
Executive Theme Champion(s):	Ms. Juliana P. Blackwell
Executive Champion Agency(ies):	**NGS, NOS, NOAA**

Table 1. Personnel Involved in Theme Management.

Geodetic Control Theme NGDA Datasets	NGDA Agency
Continuously Operating Reference Stations (CORS)	Dr. Kevin Choi, NGS, NOS, NOAA
Airborne Gravity (GRAV-D)	Ms. Monica Youngman, NGS, NOS, NOAA
Geodetic Control Information on Passive Marks	Mr. Godfred Amponsah, NGS, NOS, NOAA
Geoid Models	Dr. Yan Wang, NGS, NOS, NOAA

Table 2. NGDA Datasets within the Theme.

Human and Financial Resources Needed for Theme Management

The following table provides an estimate of resources needed for managing this Theme. It includes different activities, the roles that support them, as well as an estimated decimal Full Time Equivalent (FTE) and FTE grade. This estimate does not include the resources required for the agency to develop and maintain the NGDA Dataset(s) that make up the Theme to meet the agency's core mission requirements.

Reporting Period for Human and Financial Resources[1]: 1 OCT 2016 – 30 SEP 2017

Description of Theme Management Activities	Role *(Theme Lead, co-Theme Lead, NGDA Coordinator, other as specified)*	FTE[2]	FTE Grade
NGDA Theme management (e.g., attend meetings, review NGDA documents, develop Theme Strategic Plans, etc.)	Theme Lead	0.05	ZP-V
Other Theme administration activities	Theme Lead	0.01	ZP-V
Other Theme administration activities	Dataset Managers (x4)	0.04	ZP-IV

Table 3. Human and Financial Resources Needed for Theme Management.

Progress against Goals and Objectives

The following table shows the progress status made toward achieving the Theme's Strategic Plan goals and objectives since the last reporting period. Status categories include 'Not Started' for those activities that have not gotten underway in the reporting period; 'In Progress' for those activities underway which will continue into the next year; 'Complete' for the activities finished, or 'Recurring (completed for the current reporting period).

[1] Reporting period should align with October 1 – September 30 and be submitted by October 31.

[2] A full-time employee was available a maximum of 1952 hours during the inclusive period of October 1 – September 30; assuming a Monday-Friday schedule with 8-hour workdays and not counting Federal Holidays. The FTE was determined by taking actual number of hours worked in support of Theme Management divided by 1952 hours, rounded to the nearest 0.01.

Goals and Objectives undertaken during 2017	Status
Continuously Operating Reference Stations (CORS) Goal 1: Maintain current density of CORS sites and ensure accuracy of metadata with station owners and operators, while ensuring the network is expanded where needed and refined to better tie into the International Terrestrial Reference Frame (ITRF).	
Objective 1. The primary objective of CORS is to define, maintain and provide access to the geometric component (Latitude, Longitude, Ellipsoid Heights) of the National Spatial Reference System (NSRS). Since 95% of the stations in the CORS network are independently owned and operated, it is essential that the site owners maintain their stations. Sharing equipment changes with NGS is important because antenna changes and cables or receiver changes can result in coordinate changes which then impact all users of the data.	Recurring – complete for 2017
Objective 2. In order to better support international activities in global reference frame realization, NGS plans to build and expand foundational GNSS tracking station network with higher standards. These Foundation CORS (FCORS) sites will improve the NSRS with stronger ties to the International Terrestrial Reference Frame (ITRF). In turn, these stronger ties will better constrain future positions of all other CORS and thereby improve positional accuracy of our products to users in the field.	Recurring – complete for 2017
Continuously Operating Reference Stations (CORS) Goal 2: Encourage continued upgrade of equipment to include additional GNSS constellations beyond GPS.	
Objective 1. The CORS network requires GPS signals to be tracked by all station operators. With the increasing availability of additional GNSS constellations, supporting these new/newer signals is becoming more important.	Recurring – complete for 2017
Airborne Gravity (GRAV-D) Goal 1: Define, maintain, and provide access to the National Spatial Reference System (NSRS), specifically for gravity data throughout the United States and its territories. Gravity data are collected, processed and archived in order to provide access via online tools for a number of applications that require knowledge of the local gravity field. Gravity data also used in formation of geoid height models that provide a transformation model between GPS-derived ellipsoid heights and heights above the vertical datum. Accurate heights are critical to many industries, including floodplain definition and management, levee construction and maintenance, transportation and infrastructure development, and coastal management. See the NGDA Geoid Data set for further details.	
Objective 1. Collect and process high quality airborne gravity data for the entire U.S. and territories by 2022 to support modeling of the Earth's geoid, which will serve as a zero reference surface for all heights in the nation. This objective is under the Gravity for the Redefinition of the American Vertical Datum (GRAV-D) program.	Recurring – 64% complete for 2017 (on track for 2022)
Objective 2. Develop a plan to monitor the gravity field over time for changes that affect the geoid more than 1 centimeter. This objective is under the Gravity for the Redefinition of the American Vertical Datum (GRAV-D) program.	In Progress

Geodetic Control Information on Passive Marks Goal 1: Support and modernize the National Spatial Reference System (NSRS) in the development and maintenance of passive control to ensure alignment with the mission of the National Geodetic Survey (NGS). Major parts of the NGS Ten Year Strategic Plan (2013-2023) focus on the need to maintain access to passive control under the current realization of datums. It also stresses the need to align passive control with the future datum realizations, and improve toolkit.	
Objective 1. Maintain and support the capability to ingest, analyze, store, and disseminate internal and external survey data in the form of Bluebooking, datasheets and associated products and services.	Recurring – complete for 2017
Objective 2. Modernize and improve NSRS.	Recurring – complete for 2017 (on track for 2022)
Objective 3. Evaluate and improve the Toolkit.	Recurring – complete for 2017 (on track for 2022)
Geoid Models Goal 1: Define, maintain, and provide access to the National Spatial Reference System (NSRS), specifically for access to the current vertical datum of the United States and its territories (e.g., NAVD 88). Vertical datums are traditionally realized through a network of vertical control bench marks, which requires field crews to level between them and target areas of interest. Instead, NGS develops so-called "hybrid" geoid height models to facilitate the use of determining vertical control heights through GNSS observations. This process is much more efficient and cost saving than the traditional leveling.	
Objective 1. Hybrid geoid models are developed using geodetic control data (available as a separate NGDA data set) in combination with gravity data (another NGDA gravity data set). Because both the other NGDA data sets are continuously being updated, it necessary on an infrequent basis to determine new hybrid geoid models to be consistent with these changes. The current model is GEOID12B. It may be necessary to develop another model in 2019 (possibly GEOID19). After 2022, vertical datums for all US areas will be defined strictly by a geopotential datum defined solely by gravity data.	In Progress – none scheduled for 2017 but a model is under consideration for 2019
Geoid Models Goal 2: NGS models the Earth's static gravity field and the geoid, which will serve as a zero surface for all heights in the nation. By 2022, the orthometric heights in the geopotential reference frame will be determined to an accuracy of 2 centimeters when using 15 minutes of GNSS data.	
Objective 1. Research and develop theory, computation methods, and procedures for the determination of the Earth's gravity field and the geoid for North America and the US territories. Gravimetric geoid models provide an equipotential surface determined gravimetrically using satellite gravity models, GRAV-D airborne and terrestrial gravity data. While the GRAV-D project is in progress, experimental geoid (xGEOID) models have been computed annually using available GRAV-D data since 2014. The xGEOID models will converge to the final geoid model for the geospatial reference system in 2022.	Completed (xGEOID17)

Table 4. Theme Implementation Plan Progress Status.

Theme Implementation Plan

The following table provides details for achieving Theme Strategic Plan goals and objectives over the multi-year planning period. These include roles and responsibilities, specific actions, milestones, performance indicators and projected completion dates.

Goals and Objectives planned for 2018

Goal 1: Maintain current density of Continuously Operating Reference Stations (CORS) and ensure accuracy of metadata with station owners and operators.

Objective 1.1: The primary objective of CORS is to define, maintain and provide access to the geometric component (Latitude, Longitude, and Ellipsoid Heights) of the National Spatial Reference System (NSRS). Since 95% of the stations in the CORS network are independently owned and operated, it is essential that the site owners maintain their stations. Sharing equipment changes with NGS is important because antenna changes and cables or receiver changes can result in coordinate changes which then impact all users of the data.
Agency and/or Stakeholders Involved: NGS, FGCS, FGDC community.
Anticipated Outcome: An improved CORS network to provide positional control within the NSRS.

Actions *(Describe discrete activities)*	**Milestones** *(A significant change in development with associated date)*	**Performance Indicators** *(A metric to assess progress of the action)*	**Action Responsibility** *(Agency, individuals, and/or groups leading the action)*	**Projected Completion Date** *(FY)*
1.1.1	Install one new Foundation CORS (FCORS) per year	Contract in place, FCORS installed, data received	CORS Program Manager, CORS Branch, SRSD, NGS	FY22/Q4
1.1.2	Establish MOA's w/ other agencies for existing FCORS	MOA's completed	CORS Program Manager, CORS Branch, SRSD, NGS	F18/Q4

Agency and/or Stakeholder	**Activity through FY 2018, Q4**
NGS	Install FCORS site
CORS Site owners	Provide CORS data
NGS	Develop and sign MOA's for established sites to become FCORS
NASA, NSF, UNAVCO, OGA	Sign MOA's and agree to have established sites be treated as FCORS

Goal 2: The goal of collecting airborne gravity is to better understand the fundamental connection between Earth's gravity field and established height systems. The specific goal of the Gravity for the Redefinition of the American Vertical Datum (GRAV-D) project is to collect and process high quality airborne gravity data to support modeling of the Earth's geoid, which will serve as a zero reference surface for all heights in the nation. Accurate heights are critical to numerous commercial and scientific endeavors, ranging from safe and efficient transit for commerce and transportation systems, to promoting American ingenuity, technology and employment for economic benefit, to providing national leadership for understanding and safeguarding coastal environments.

Objective 2.1: In FY18 complete cumulative airborne gravity data collection for 70% of the United States and territories.
Agency and/or Stakeholders Involved: NGS.

Anticipated Outcome: Aerogravity flights are flown, processed and released.

Actions *(Describe discrete activities)*	**Milestones** *(A significant change in development with associated date)*	**Performance Indicators** *(A metric to assess progress of the action)*	**Action Responsibility** *(Agency, individuals, and/or groups leading the action)*	**Projected Completion Date** *(FY)*
2.1.1	Collected Aerogravity	Cumulative data collection of 65% of the target area	GRAV-D Program Manager	FY18/Q1
2.1.2	Collected Aerogravity	Cumulative data collection of 66% of the target area	GRAV-D Program Manager	FY18/Q2
2.1.3	Collected Aerogravity	Cumulative data collection of 68% of the target area	GRAV-D Program Manager	FY18/Q3
2.1.4	Collected Aerogravity	Cumulative data collection of 70% of the target area	GRAV-D Program Manager	FY18/Q4

Agency and/or Stakeholder	**Activity through FY 2018, Q4**
NGS	Collect airborne gravity data to support the new vertical datum.
NGS	Process and release of airborne gravity data.

Goal 3: Continue to support the modernization of the National Spatial Reference System (NSRS) in the development and maintenance phase of passive control, and to ensure its alignment with the mission of the National Geodetic Survey (NGS).

Objective 3.1: Major parts of the NGS Ten Year Strategic Plan (2013-2023) focus on the need to maintain access to passive control under the current realization of datums. It also stresses the need to align passive control with the future datum realizations, and improve toolkit.
Agency and/or Stakeholders Involved: NGS.
Anticipated Outcome: NSRS Database will be better established to replace existing NGS IDB database.

Actions *(Describe discrete activities)*	**Milestones** *(A significant change in development with associated date)*	**Performance Indicators** *(A metric to assess progress of the action)*	**Action Responsibility** *(Agency, individuals, and/or groups leading the action)*	**Projected Completion Date** *(FY)*
3.1.1	On-going mission requirement	On track for FY 2018	NGS	Recurring – complete for 2018
3.1.2	On-going mission requirement	On track for FY 2018	NGS	Recurring – complete for 2018 (on track for 2022)
3.1.3	On-going mission requirement	On track for FY 2018	NGS	Recurring – complete for 2018 (on track for 2022)

Goal 4: Support the nation's new national geospatial reference system beyond 2022.

Objective 4.1: In 2022, the NAVD88 and NAD83 will be replaced by a new national geospatial reference system. The primary objective of gravimetric geoid models is to provide an equipotential surface determined gravimetrically using satellite gravity models, GRAV-D airborne and terrestrial gravity data. While the GRAV-D project in progress, experimental geoid (xGEOID) models have been computed annually using available GRAV-D data since 2014. The xGEOID models will converge to the final geoid model for the geospatial reference system in 2022.
Agency and/or Stakeholders Involved: NGS.
Anticipated Outcome: xGEOID18 model released on web.

Objective 4.2: Additionally, NGS will cooperate with NGA to develop PGM20xx models in order to develop the EGM2020 model. These will be iterative models between xGEOIDxx and PGM20xx models.
Agency and/or Stakeholders Involved: NGS/NGA.
Anticipated Outcome: Aerogravity provided to NGA/PGM2018 received for evaluation.

Actions *(Describe discrete activities)*	**Milestones** *(A significant change in development with associated date)*	**Performance Indicators** *(A metric to assess progress of the action)*	**Action Responsibility** *(Agency, individuals, and/or groups leading the action)*	**Projected Completion Date** *(FY / Quarter)*
4.1.1	Clean latest aerogravity data	Latest GRAV-D data are cleaned	Geoid Team Lead	FY18/Q2
4.1.2	Combine all available gravity	Merged datasets and models	Geoid Team Lead	FY18/Q3
4.1.3	Produce xGEOID18	Final model produced	Geoid Team Lead	FY18/Q4
4.1.4	Release xGEOID18	Outreach and web release	Geoid Team Lead	FY18/Q4
4.2.1	Forward cleaned aerogravity and xGEOID18 model to NGA	Merged datasets and models	Geoid Team Lead/NGA	FY18/Q3

Agency and/or Stakeholder	**Activity through FY 2018, Q4**
NGS	Develop xGEOID18
NGS	Release xGEOID18

Table 5. Theme Implementation Plan.